Task Book Report Generated on: 04/23/2024

Pi Name: Bosser, Mathias M.D., Ph.D. Project Title: Long-Term Brain Structural and Functional Consequences of Spaceflight Frogram/Discipline: Frogram/Discipline- Element/Subdiscipline- Element/Subdisciplin	Fiscal Year:	FY 2021	Task Last Updated:	FY 10/04/2021
Division Name: Human Research Program/Discipline: Program/Discipline: Program/Discipline- Element/Subdiscipline: Joint Agency Name: TechPort: No Joint Agency Name: Clark State State Joint Agency Name: No Joint Agency Name: Nam	PI Name:	Basner, Mathias M.D., Ph.D.		
Program/Discipline: Program/Discipline- Element/Suddiscipline- Eleme	Project Title:	Long-Term Brain Structural and Functional Consequences of Spaceflight		
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Space Biology Cross-Element Discipline: Space Biology Special Category: None PI Email: basner@pennmedicine.upenn.edu Fax: FY PI Organization Type: UNIVERSITY Phone: 215-573-5866 Organization Name: University of Pennsylvania PI Address 1: Department of Psychiatry, Division of Sleep and Chronobiology PI Address 2: 423 Service Dr, 1013 Blockley Hall PI Web Page: City: Philadelphia State: PA Zip Code: 19104-4209 Congressional District: Comments: Project Type: GROUND G	Human Research Program Risks:	(2) SANS:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
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Key Personnel Changes/Previous PI:	Flight Assignment:			
	Key Personnel Changes/Previous PI:			

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Grant/Contract No.:

80NSSC21K1698

Performance Goal No.:

COI Name (Institution):

Performance Goal Text:

Task Description:

Magnetic Resonance Imaging (MRI) of the brain before and immediately following long-duration International Space Station (ISS) flights as well as Antarctic winter-over missions have revealed structural changes, but the time course of recovery and clinical significance remain unclear. This international proposal will "determine if exposure to long-duration spaceflight leads to neural structural alterations and if this remodeling impacts cognitive and functional performance" (HRP Gap CBS-SM26). To accomplish this, we propose to leverage data from our already funded integrated 1-Year Mission Project (i1YMP) and extend the follow-up period for N=20 astronauts on 6- and 12-month ISS missions to 3-years post-flight (this follow-up period can be extended should structural and functional brain changes not be fully reversible within 3 years after return from the ISS). Measures of cognitive function include the Cognition test battery (developed by NASA Principal Investigator Dr. Basner and his team), a Spatial Cognition test battery (developed by German Aerospace Center (DLR)/European Space Agency (ESA) Principal Investigator Dr. Stahn and his team), and NASA's standard WinSCAT test battery (which currently is last performed 30 days post-flight). These tests will be performed up to 7 times post-flight, which will provide an exceptional resolution in mapping the recovery time course of any observed decrements in cognitive performance across a wide range of cognitive domains and constructs. The cognitive data will also be used to either extend existing or start building normative databases. In our i1YMP, we perform structural and functional MRI scans in astronauts before and immediately after the mission. These scans include, but go beyond, protocols that were the basis for several recent publications that observed structural brain changes in astronauts immediately post-flight and can thus augment these data sets. In our i1YMP, astronauts perform a functional MRI version of Cognition (Project A) as well as a complex Mars navigation task (Project B) in the scanner, which allows us to link task-specific changes in brain plasticity with any relevant changes in neurobehavioral performance with the Cognition and Spatial Cognition batteries, and assess their neural basis. T1- and T2-weighted structural scans will be used to investigate changes in brain structures that have been implicated in the development of the Spaceflight Associated Neuro-ocular Syndrome (SANS) (e.g., upward shift of the brain, increases in cerebrospinal fluid (CSF) volume with periventricular white matter hyperintensities; Human Research Program (HRP) Gaps SANS1 and 13; Project A) and that have been shown to be most vulnerable to spaceflight stressors (i.e., visuospatial brain domain changes; Project B). Seven post-flight scans (R+3, R+5, R+30, R+180, R+360, R+720, R+1080) will provide an unmatched resolution in mapping the recovery time course. Clinical significance of cognitive and MRI data will be based on deviations from pre-flight measurements as well as from normative data collected in other astronauts and astronaut-surrogate populations.

In summary, this international project will monitor changes in brain structure and function up to 3-years post-flight to determine 1) whether they persist in some astronauts, 2) if so, for how long, and 3) whether there are any long-term health consequences. It will thus deliver critical insights into the time course of brain changes and their functional relevance observed in astronauts after ISS missions lasting 6-months and longer. Synergies between the projects will be used to provide NASA and DLR/ESA with insights that go beyond the specific aims of the individual projects.

[Ed. Note, Sept 2021: HRP Gap numbers listed above are not current. For the current list of HRP Gaps, see updates at the Human Research Roadmap: https://].

Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

Task Progress:

New project for FY2021.

Bibliography Type:

Description: (Last Updated: 04/05/2024)